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Completion of One Year Bioventing . . .

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DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE
BROOKS AIR FORCE BASE TEXAS

6 Mar 95

MEMORANDUM FOR 439 SPTG/CEV
ATTN: Mr. Jack Moriarty
250 Patriot Ave., Suite 1
Westover Air Reserve Base, MA 01022-1670

FROM: HQ AFCEE/ERT
8001 Arnold Drive
Brooks AFB TX 78235-5357

SUBJECT: Completion of One Year Bioventing Test, Building 7705

The Air Force Center for Environmental Excellence (AFCEE) one-year bioventing test and evaluation project at Building 7705 has been completed. Figure 1 provides general site information and Table 1 provides a summary of initial, six-month, and one-year fuel respiration and degradation rates measured at several monitoring points. Overall, biodegradation rates have decreased over the one-year pilot test. These decreases are best explained by the reduction of contaminant levels as the bioventing continued. Table 2 provides a summary of initial and final soil and soil gas analytical results for total recoverable petroleum hydrocarbons (TRPH) and benzene, toluene, ethyl benzene, and xylenes (BTEX). Based on results from your site and 124 other sites currently under operation, bioventing is cost-effectively remediating fuel contamination in a reasonable time frame. We recommend its application at other sites on your installation using the criteria in the AFCEE Test Plan and Technical Protocol for a Field Treatability Test for Bioventing, May 1992, including Addendum One, February 1994. These are found in the "Tool Box" recently sent to your base.

The objective of the one-year sampling effort was not to collect the large number of samples required for statistical significance. It was conducted to show relative reductions in TRPH and BTEX concentrations. Soil gas samples are somewhat similar to composite samples in that they are collected over a wider area. Thus, they provide a good indication of changes in soil gas profiles and volatile contaminant concentrations (see Addendum One to Test Plan and Technical Protocol for a Field Treatability Test for Bioventing - Using Soil Gas Surveys to Determine Bioventing Feasibility and Natural Attenuation Potential, February 1994). Soil samples, on the other hand, are discrete point samples subject to large variabilities over small distances/soil types. Given this variability, coupled with known sampling and analytical variabilities, a large number of samples would have to be collected to conclusively determine "real" changes in soil contamination. Because of the limited number of samples, these results should not be viewed as conclusive indicators of bioventing progress or evidence of the success or failure of this technology. In situ respiration tests are considered to be better indicators of hydrocarbon remediation than limited soil sampling.

The soil analytical results for Building 7705 are not conclusive. Both the initial and one-year soil analysis for this site indicate low contamination levels. Overall, this site does not appear to be very contaminated. The respiration tests indicate some degradation is occurring. No oxygen utilization was observed during the six-month respiration test. This is most likely the result of natural oxygenation of the site. With the low levels of contamination and colder soil temperatures, it is possible that natural oxygen replenishment was faster than oxygen utilization. We recommend that the system continue to operate until respiration tests indicate background respiration rates for clean soils. Additional respiration testing and site close-out testing for the bioventing system can be contracted through AFCEE. Please contact Jerry Hansen, AFCEE/ERT, DSN 240-4353, COM 210-536-4353, to discuss technical and contractual options for full-scale expansion.

Data from your base and many others indicate that BTEX compounds are preferentially biodegraded over TRPH. Since BTEX compounds represent the most toxic and mobile fuel constituents, a BTEX standard is a risk-based standard. We strongly encourage its use over an arbitrary TPH standard. Within the AFCEE Risk-based Petroleum Hydrocarbon "Tool Box," the reported entitled "Use of Risk-based Standards for Cleanup of Petroleum Contaminated Soil," summarizes the BTEX/TPH issue and will assist you in negotiating for a BTEX cleanup standard.

In general, quantitative destruction of BTEX will occur over a one- to two-year bioventing period. Soil gas surveys and respiration tests can be used as BTEX destruction indicators. If a non-risk-based/TRPH cleanup is chosen, the pilot and full-scale systems should be operated until respiration rates approach background rates. We recommend that confirmatory soil sampling be conducted four to six months after background respiration rates are approached.

Because this is a streamlined test and evaluation project, our contract does not provide for additional reports to the base on pilot study results. The interim results report contains as-builts and initial data. This letter summarizes all data collected and provides next step recommendations. AFCEE is no longer responsible for the operation, maintenance, or monitoring of the bioventing systems. We are initiating a contract to extend monitoring at some sites beyond the initial one-year test. Monitoring will include soil gas and respiration tests to document hydrocarbon degradation, but may also include the collection of sufficient final soil samples to statistically demonstrate site cleanup. If you are interested, please call us.

The blower and accessories are now base property and should continue to be used on this or other bioventing sites. Although current equipment is explosion proof, under no circumstances should it be used for soil vapor extraction unless appropriate explosion-proof wiring is provided. If the base does not want to keep the blower or if you have further questions, please contact us.

On behalf of the AFCEE/ERT staff, I would like to thank you for your support of these bioventing test and evaluation projects. The information gained from each site will be invaluable in evaluating this technology and will promote its successful application on other DOD, government, and private sites. I have attached a customer satisfaction survey. Please take a few minutes to fill it out and tell us how we did. We look forward to hearing from you.

ROSS N. MILLER, Lt Col, USAF, BSC
Chief, Technology Transfer Division

Attachments:
1. Building 7705 Data
2. Survey

cc: AFCEE/ERD (Capt Harcarik)
HQ AFRES/CEVR

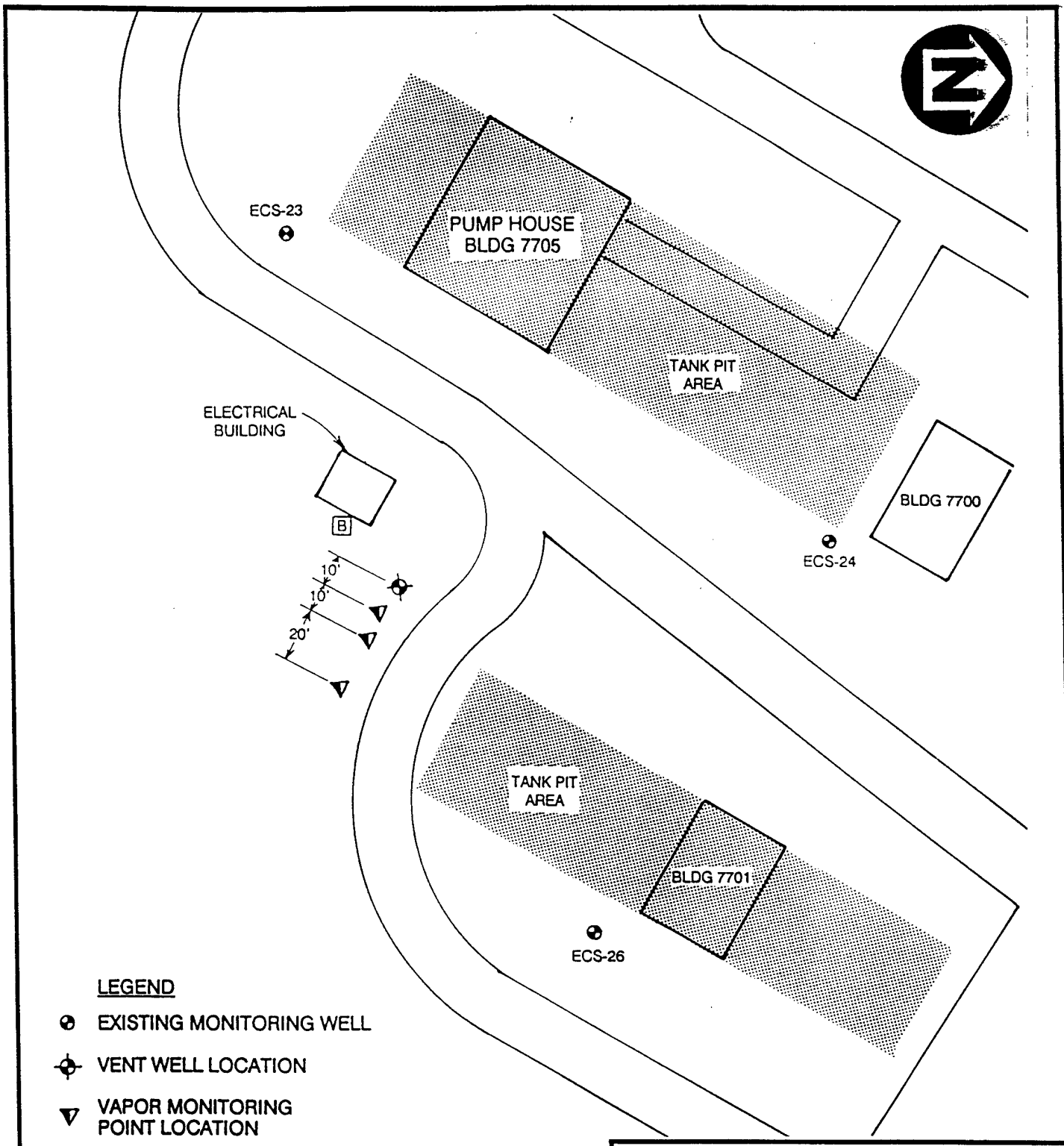

FIGURE 1

PILOT STUDY TEST AREA
BUILDING #7705

Westover AFB, Massachusetts

PARSONS
ENGINEERING SCIENCE, INC.
Denver, Colorado

TABLE 1
BUILDING 7705
RESPIRATION AND DEGRADATION RATES
WESTOVER AFB, MASSACHUSETTS

Location–Depth	Initial			6–Month[b/]			1–Year		
	K_o (% O_2/min)	Degradation Rate (mg/kg/year)[a/]	Soil Temperature (°C)	K_o (% O_2/min)	Degradation Rate (mg/kg/year)	Soil Temperature (°C)	K_o (% O_2/min)	Degradation Rate (mg/kg/year)	Soil Temperature (°C)
VW	0.0023	390	NS[c/]	0	0	NS	0.0011	170	NS
MPC–8.5	0.0017	520	NS	0	0	NS	0.00049	160	NS
MPC–13.5	0.0019	210	NS	0	0	NS	0.0009	300	NS
MPA–5.5	NS	NS	15.2	NS	NS	10.4	NS	NS	10.4
MPA–13.5	NS	NS	16.3	NS	NS	8.0	NS	NS	15.6

[a/] Milligrams of hydrocarbons per kilogram of soil per year.
[b/] No oxygen utilization was observed during the 6–month respiration tests.
[c/] NS = Not sampled.

TABLE 2

BUILDING 7705
INITIAL AND 1-YEAR SOIL AND SOIL GAS ANALYTICAL RESULTS
WESTOVER AFB, MASSACHUSETTS

Analyte (Units) [a/]	Sample Locations-Depth (feet below ground surface)					
	VW		MPA-13.5		MPC-13.5	
Soil Gas Hydrocarbons	Initial [b/]	1-Year [c/]	Initial	1-Year	Initial	1-Year
TVH (ppmv)	2.7	0.56	2.3	0.13	270	0.33
Benzene (ppmv)	<0.001	<0.002	<0.001	<0.002	<0.054	<0.002
Toluene (ppmv)	<0.001	0.012	<0.001	0.01	<0.054	0.006
Ethylbenzene (ppmv)	0.001	0.014	0.001	0.003	0.36	0.002
Xylenes (ppmv)	0.014	0.041	0.017	0.014	0.23	0.014
	VW-18-20		MPA-12-14		MPC-8-10	
Soil Hydrocarbons	Initial [d/]	1-Year [e/]	Initial	1-Year	Initial	1-Year
TRPH (mg/kg)	61	<12.7	<0.59	<10.4	<5.2	<10.3
Benzene (mg/kg)	<0.069	<0.05	<0.0006	<0.050	<0.0005	<0.050
Toluene (mg/kg)	1.4	0.55	0.0007	<0.050	<0.0005	<0.050
Ethylbenzene (mg/kg)	<0.069	0.21	<0.0006	<0.050	<0.0005	<0.050
Xylenes (mg/kg)	2.2	0.95	0.0034	<0.099	<0.0007	<0.099
Moisture (%)	11	20.6	14	2.7	4.4	3.5

[a/] TVH=total volatile hydrocarbons: ppmv = parts per million, volume per volume;
TRPH = total recoverable petroleum hydrocarbons; mg/kg = milligrams per kilogram.

[b/] Initial soil gas samples collected on October 27, 1993.

[c/] Final soil gas samples collected on November 30, 1994.

[d/] Initial soil samples collected on October 12-13, 1993.

[e/] Final soil samples collected on November 18, 1994.

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